Ecological Assessment Report

White Rock Wind Farm
Near Glen Innes, NSW

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Disclaimers

Executive Summary

This report undertakes a flora and fauna assessment for a proposal south-west of Glen Innes, NSW. The proposal would comprise 119 wind turbines, with a maximum height of 150 metres, and associated powerlines and access roads.

Two Endangered Ecological Communities (EECs) were identified within the study area, namely, Ribbon Gum – Mountain Gum Woodland (EEC – Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland of the New England Tableland Region) and Yellow Box Woodland (EEC White Box Yellow Box Blakely's Red Gum Woodland). No threatened flora species as listed on the Threatened Species Conservation Act 1995 (TSC Act) and Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) were identified within the study area during field surveys. Potential habitat within the study area was identified for three threatened flora species identified during database searches.

Assessment of the potential level of impact on EECs and threatened flora species listed under the TSC Act identified one EEC and four threatened flora as potentially impacted by the proposal. For EECs and flora species the positioning of wind turbines in areas to avoid forest/woodland vegetation resulted in proposed powerline easements and access roads as requiring most woodland/forest vegetation removal. The relatively small area of vegetation that would be removed for the wind farm in relation to much larger amount available in the immediate area resulted in a finding of no significant impact on EECs or threatened flora species listed under the TSC Act.

Three threatened fauna species were recorded during field surveys namely, the Eastern Bentwing-bat (*Miniopterus schreibersii*), Little Pied Bat (*Chalinolobus picatus*) and Varied Sittella (*Daphoenositta chrysoptera*). Potential habitat within the study area was identified for five threatened species during database searches.

Assessment of the potential level of impact on threatened fauna species under the TSC Act identified seven threatened fauna species as potentially impacted by the proposal. The seven fauna species are the Turquoise Parrot (*Neophema pulchella*), Grey-headed Flying-fox (*Pteropus poliocephalus*), Eastern Bentwing-bat, Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Greater Long-eared Bat (*Nyctophilus timoriensis*) and Little Pied Bat. The proposal was considered unlikely to have a significant impact on any of the seven threatened fauna species listed under the TSC Act.

The proposal was also found to have no significant impact on any ecological communities, threatened species or migratory species as listed under the EPBC Act.

Recommendations have been made to minimise and monitor the potential impacts of the proposal, including the implementation of a Construction Management Plan, an Environmental Management Plan and an Adaptive Management Plan. Offsets will also be provided to compensate for the loss of impact vegetation and habitat.

Terms & Abbreviations

Abbreviation	Meaning
API	Aerial Photograph Interpretation
CRZ	Core Riparian Zone
DECCW	Department of Environment, Climate Change and Water
DEWHA	Department of Environment, Water, Heritage and the Arts (now SEWPAC)
DoP	Department of Planning
DWE	Department of Water and Energy
EEC	Endangered Ecological Communities
EP&A Act	Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Act 1999
LGA	Local Government Area
NPWS	National Parks and Wildlife Service
ROTAP	Rare or Threatened Australian Plants
RPS	RPS Australia East Pty Ltd
SAT	Spot Assessment Technique
SEPP 44	State Environmental Planning Policy No. 44
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
TSC Act	Threatened Species Conservation Act 1995

Contents

Figures

Tables

Appendices

1 Introduction

RPS has been commissioned by Epuron to undertake an Ecological Assessment for a proposed wind farm development at White Rock, near Glen Innes, on the New England Tablelands of New South Wales (NSW) (Figure 1-1). This study by RPS was undertaken as part of the Environmental Assessment (EA) to support an application for Project Approval under Part 3A of the EP&A Act.

The report has been structured and conducted to fulfil the requirements of the Environmental Planning and Assessment Act 1979 (EPA Act), the TSC Act and the Fisheries Management Act 1994 (FM Act). Assessment of the proposal under the requirements of State Environmental Planning Policy No. 44 (SEPP 44) – 'Koala Habitat Protection' is included. Consideration of the proposal has also been undertaken in relation to the Commonwealth EPBC Act.

Director General's Requirements (DGRs) have been issued by the NSW Department of Planning (DoP) for the project. The DGRs identify certain requirements that must be incorporated into the flora and fauna assessment aspect of the project. These include consideration of Assessing the Impacts on Birds – Protocols and Data Set Standards, (Australian Wind Energy Association), the Auswind (2005) Wind Farms and Birds: Interim Standards For Risk Assessment, adhering to State Draft Guidelines for Threatened Species Assessment and having regard to the Department of Environment and Heritage's (DEH) Cumulative Risk for Threatened and Migratory Species, March 2006. These requirements (and the requirements of other relevant documentation such as EPBC Act Policy Statements) have been considered and are referred to throughout this assessment where appropriate.

1.1 Purpose and Scope

The purpose of this ecological assessment report is to:

- enable the presence or likely presence of components of biodiversity to be documented prior to the making of planning, land management and development decisions for the proposal;
- enable planning, land management and development decisions to be based on sound scientific information and advice;
- identify and document the known and potential ecological impacts of the proposal; and
- enable compliance with applicable assessment requirements contained within the EPA Act, TSC Act, FM Act, EPBC Act, and any other relevant state, regional and local environmental planning instruments.

1.2 Site Particulars

Locality – White Rock, New England Tablelands (see **Figure 1-1**).

LGA – Glen Innes Severn Council and Inverell Shire Council. Most of the project is located within Glen Innes Severn LGA.

Study Area – 9,662 ha, this includes the area of all the properties in which wind turbines are proposed to be located. The actual on-ground study has been limited to the provided development envelope areas, which encompass an area of approximately 1,361 ha.

Zoning – Rural 1(a)

Current Land Use – Cattle and sheep grazing, agricultural production, rural dwellings.

Topography – The study area lies on the Great Dividing Range (New England Range) with height ranges of 880 - 1420 metres AHD.

Vegetation – Mainly cleared, although remnant patches of tall open forests and open forests composed of Ribbon Gum, Mountain Gum, Snow Gum and Black Sally on the basalt plateau.

1.3 Project Summary

1.3.1 The Project

The White Rock Wind Farm (WRWF) study area is located generally in the area between Grahams Valley Road and Gwydir Highway, approximately 20km west of Glen Innes in the New England Tablelands of northern NSW. The proposal is known as the White Rock Wind Farm and consists of 119 wind turbines. The proposed layout for the WRWF is illustrated in **Figure 1-2**. Hereafter the proposal is referred to as the 'proposal'.

The components of the proposed wind farm included in this application are:

- 119 wind turbines, each with:
  - » three blades mounted on a tubular steel tower with a combined height of a blade and tower restricted to a maximum tip height of 150 metres;
  - » an adjacent pad mounted turbine transformer, crane hardstand area, and related turbine laydown area;
- a 132kV switching station at the connection point to the TransGrid 132kV transmission line, and a 132kV substation on site;
- electrical connections between wind turbines and the on-site substation, which would be a combination of underground cable and overhead powerlines linking sections of the site;

- an operation and maintenance facility incorporating a control room and equipment storage facilities;
- temporary concrete batching plant facilities;
- access tracks required for each turbine and the related facilities above;
- minor upgrades to access on local roads, as required for the installation and maintenance of wind turbines and the related facilities above; and
- a number of permanent monitoring masts for wind speed verification and monitoring.

A range of turbines are being considered with a capacity between 1.5 and 3.4 megawatts. For ease of presentation the EA will refer to an indicative capacity of 240 MW based on a typical 2.0 MW turbine. The works establishment of the wind farm can be considered as occurring in four phases. These include construction, operation, refurbishment and decommissioning of the wind farm.

The turbines will be connected via a combination of underground cable and overhead powerlines. Each turbine will have a substation and transmission line connecting the wind farm to the new TransGrid 132kV transmission line, which intersects the north of the study area. Additional infrastructure include an operation and maintenance facility, temporary concrete batching plant facilities and a number of permanent monitoring masts.

Access roads to the turbines will be constructed to allow delivery of the turbines and also ongoing maintenance. Some existing roads are likely to be upgraded at certain points to improve access.

For the purposes of this ecological assessment Epuron has provided estimated impact areas.

Impact buffers of 25 x 60m have been assessed around turbine locations and a 10m width has been assessed for access tracks. The easement for the 132 kV power line connecting the wind farm to the TransGrid line will be 40m wide and for the 33 kV overhead lines on the wind farm between the ridges will be up to 25m wide. Vegetation clearance is not required for the full easement width and will depend on the final line design. Vegetation clearance required from the conductors will vary from 2m at the poles to between 4m and 6m at mid-span. The design of the power lines can also be varied to reduce the impact on any specific areas of vegetation; for example by using taller poles or converting a section of the line to aerial bundled cable (ABC) which can be installed through trees with a minimum conductor clearance of 0.5m. The poles for the 33kV line are typically 15 to 25m high with spacing of 150 to 250m. Clearing estimates are based on the above as a worst case scenario; actual clearing may be substantially less than the estimate.

1.3.2 Project Refinement Process

In order to minimise the potential impacts upon sensitive environments and species, an initial layout put forward by Epuron was assessed in relation to outcomes of the ecological field survey. The initial layout resulted in a number of turbines and / or roads and cables being located within remnant native vegetation areas.

From site surveys and aerial photo interpretation it was apparent that modifications could be made to the design to ensure that impacts to native species and habitat could be avoided and / or minimised. These important environments were considered in the reshaping process to provide the most sensitive environmental outcome possible, while still ensuring that the project was economically viable and socially responsible.

By maximising the distance of wind turbines from forested vegetation, the potential for bird and bat collisions is also likely to be significantly reduced. This is because the guilds of focus, being bird and bats in particular, are known to use the edges of forested vegetation as markers when moving or migrating through an area. Many species of birds and bats also forage at this interface between cleared areas and forested areas.

In addition, protecting forested areas of EEC has been a focus of the project refinement process as the EEC vegetation types are of conservation significance themselves while also providing habitat for a range of flora and fauna species, including threatened species. By protecting the natural habitat on the site to the maximum extent possible the project in turn has protected the vast majority of habitat for vegetation communities and threatened flora and fauna in the locality.

While impact to bats via blade strike, barotrauma and habitat displacement are important, protection of bat habitat itself was considered to be a priority. Recorded impact rates from such impacts are relatively low. These are further discussed in detail later in this document. As such, protection of their known or likely breeding and foraging habitat was considered to be the priority.

Similarly, while impacts to birds via blade strike and habitat displacement are important, protection of the bird habitat itself was considered to be a priority. Recorded impact rates from such impacts are relatively low. These are further discussed in detail later in this document. As such, protection of their known or likely breeding and foraging habitat was considered to be the priority.

While protecting natural habitats has been a focus of the design process it must still be recognised that in order for the project to remain viable, a minimum number of turbines must be incorporated into the design and these must be logically situation on the higher points of the study area. Limited consideration can be given to alternative sites other than that which has already been given, as the locations in which the propsed turbines are located are the reason the project is viable. It is considered by the client Epuron that the current refined layout retains the viability of the project. In addition as mentioned above the refined design provides for best practice consideration of biodiversity issues.

An example of the refinement process in action is presented in the plates below.

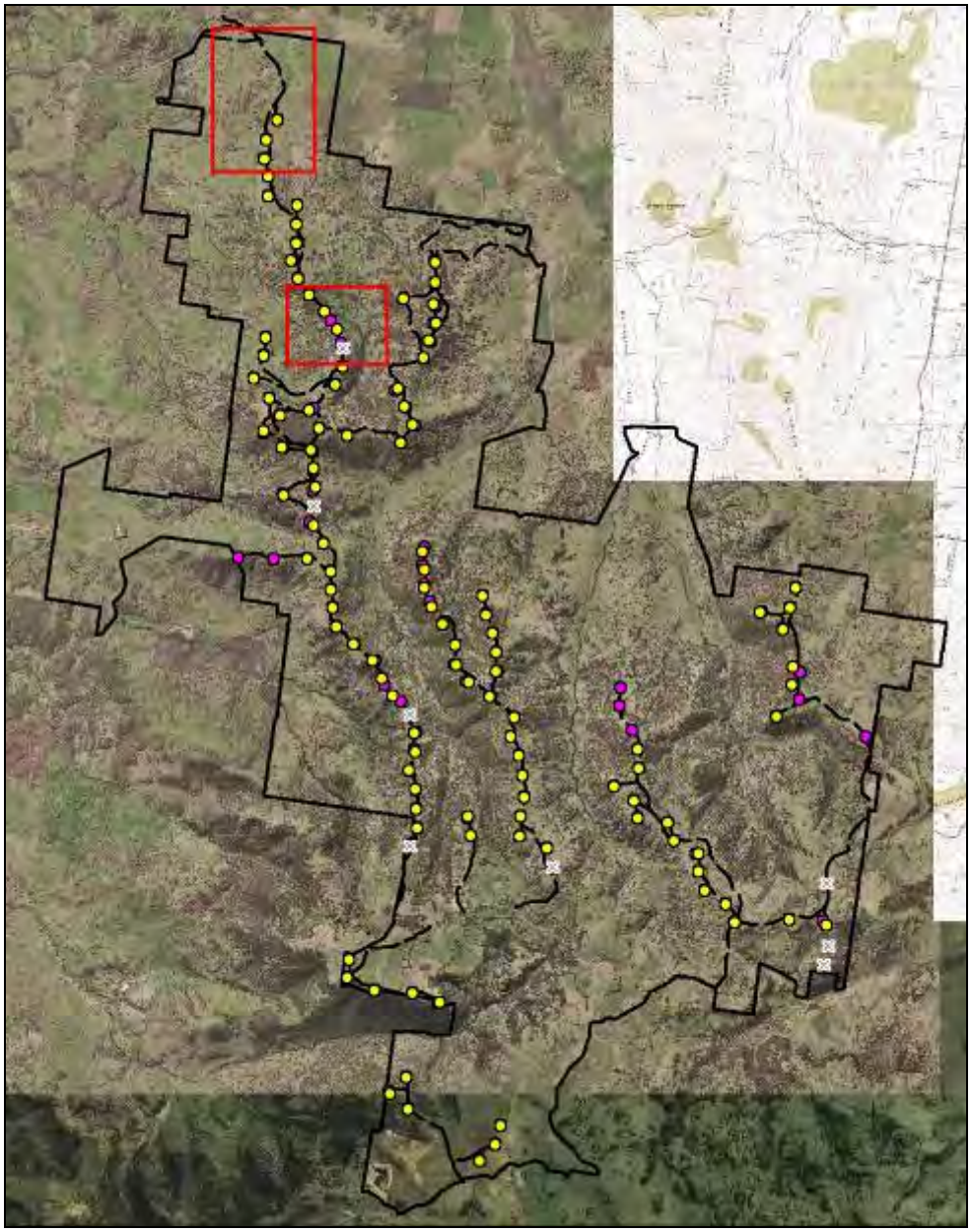
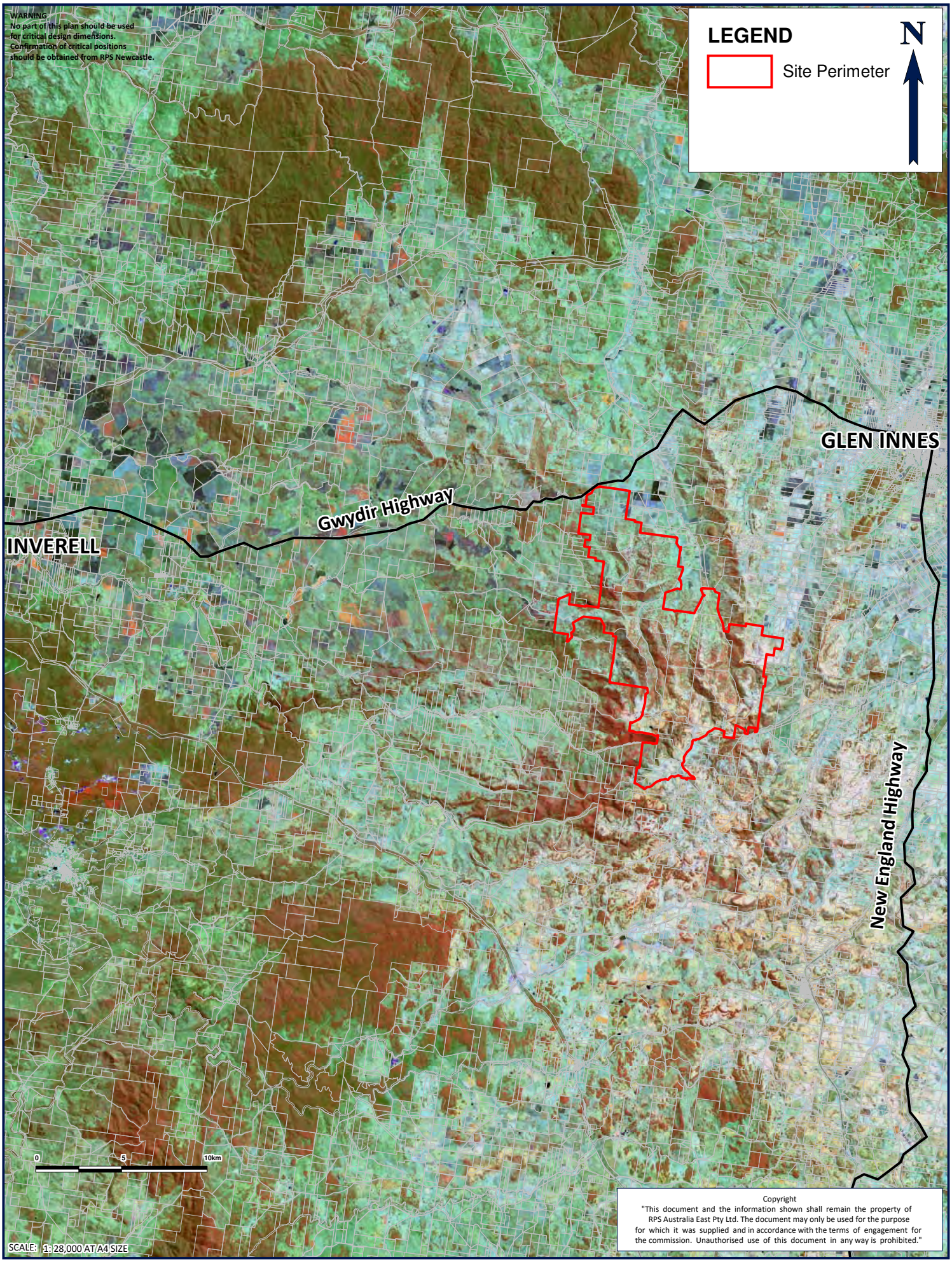


Plate 1: Example of an initial layout. X – 8 removed turbines. Pink – relocated turbines.

Plate 2: Example of relocated turbines. Yellow – original location in remnant vegetation. Pink – revised locations in disturbed areas.

Plate 3: Example of relocated transmission line to avoid Yellow Box EEC. Grey – original transmission line location. Orange – relocated transmission line.



TITLE: FIGURE 1-1 STUDY LOCALITY
LOCATION: WHITE ROCK
DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)
DATE: 22/11/2010
PURPOSE: REPORT FIGURE
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LAYOUT REF:\White Rock\Ecology\Report Figures
VERSION (PLAN BY): A A4 (NW-SC)

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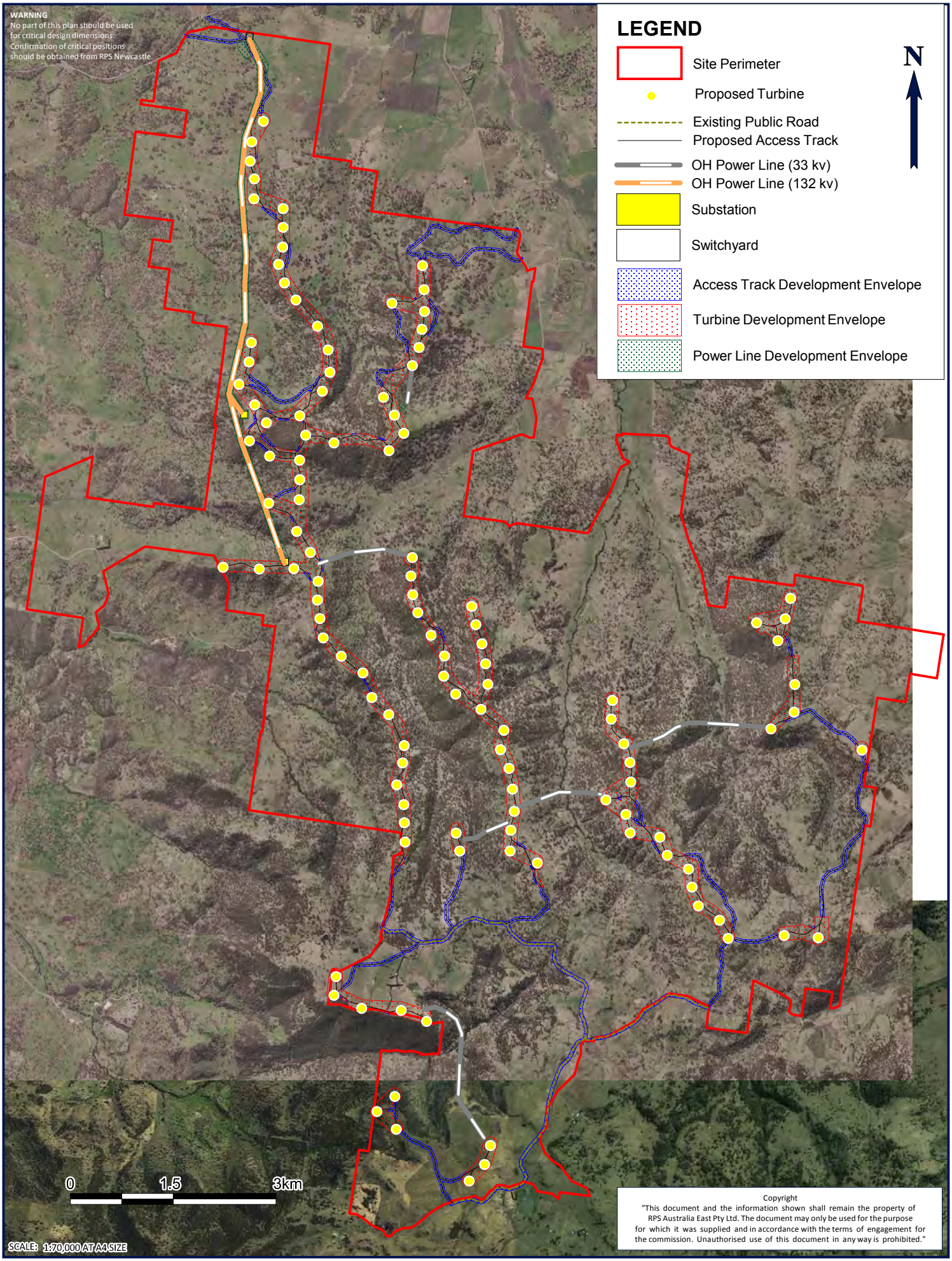

TITLE: FIGURE 1-2 PROJECT LAYOUT

LOCATION: WHITE ROCK

DATUM: N/A
PROJECTION: MGA ZON 56 (GDA 94)

DATE: 24/11/2010
PURPOSE: REPORT FIGURE

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VERSION (PLAN BY): B A4 (NW-SC)

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1.4 Qualifications, Licensing and Certification

1.4.1 Qualifications

The report and the information from which it was collated, was undertaken by Paul Hillier (BEnvSc), with additional input and review from Steven Cox (B.App.Sc (Hons)) and Toby Lambert (BEnvSc) (see Appendix 2 for more detail).

1.4.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S10300 (Valid 30 November 2010 – currently awaiting approval of renewal application);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2011);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2011).

1.4.3 Certification

As the principle author, I, Toby Lambert make the following certification:

The results presented in the report are, in the opinion of the principle author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the study area;

All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the Animal Research Act 1995, National Parks and Wildlife Act 1974 and the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes.

Toby Lambert
Senior Ecologist – Senior Project Manager
BEnvSc MECA

2 Methodology

Ecological field investigations were undertaken within the study area from 25 September 2010 to 1 October 2010.

Consideration has been given to the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC 2004) and the addendum Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians (DECC 2009). However flora and fauna assessments for wind energy projects, particularly within rural landscapes, require a modified approach to the flora and fauna survey methods normally undertaken for development proposals, such as those required under these working draft guidelines.

The approach detailed herein has therefore also taken into consideration the more wind assessment-specific Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (Auswind 2006) and the Wind Farms and Birds: Interim Standards For Risk Assessment (Auswind 2005).

Wind turbines by their very nature need to be located away from any remnant vegetation that may disrupt wind currents and velocities. Therefore the assessment of potential impacts requires a shift in focus towards the identification of species at risk of collision with turbines, movement patterns of birds / bats, and key habitat areas and corridors in the vicinity of the turbines. The impacts associated with the infrastructure that is required to operate and service the turbines, including cabling, roads, and substation(s) also require investigation.

With regards to the current proposal, the majority of survey effort was given to bird and bat surveys (identification of species at risk of collisions), vegetation mapping (eg. presence of endangered ecological communities), and habitat assessment (eg. identification of key habitats, potential movement corridors). Such an approach is consistent with the relevant requirements of DEH (2005), DEC (2004), Auswind (2005), Auswind (2006) and Planning NSW (2002).

The flora and fauna survey methods, as detailed herein, provide sufficient baseline information to make an assessment of the potential use of the study area by threatened species (as listed under the TSC Act and the EPBC Act) and to detail the known and potential ecological impacts of the proposal. They also provide baseline data to be used in future monitoring of the operating wind farm.

2.1 Data Collation and Literature Review

A review of the information relating to the potential environmental impacts of wind turbines was undertaken. Biodiversity / threatened species data relevant to the study area and the wider region was also obtained. Important information sources included:

- Atlas of NSW Wildlife (NSW National Parks & Wildlife Service). Accessed October

2010 including the Guyra, Glen Innes, Bundarra and Inverell 1:100 000 map sheets;

- AusWEA (2005) *Wind Farms and Birds: Interim Standards For Risk Assessment*. Australian Wind Energy Association. July 2005.
- AusWEA (2004) *Fact Sheet 8: Wind Farms & Bird & Bat Impacts*. Australian Wind Energy Association.
- AusWEA (2002) *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*. Australian Wind Energy Association. March 2002;
- Benson, J.S. and Ashby, E.M. (2000) Vegetation of the Guyra 1:100 000 map sheet New England Bioregion, New South Wales. *Cunninghamia* **6(3)**: 747-872;
- Birds Australia "Bird Atlas". Species lists for the 1-degree block covered by the study area. (http://www.abc.net.au/birds/). Accessed September 2010;
- DEC (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities – Working Draft*. November 2004.
- DEH (2006) *Wind farm collision risk for birds – Cumulative risks for threatened and migratory species.* Prepared by Biosis Research Pty Ltd.
- DEH (2005) *EPBC Act Policy Statements, Supplementary Significant Impact Guidelines 2.1.1 Wind Farm Industry Sector*
- DEH Environment Protection and Biodiversity Conservation Act Protected Matters Search Tool (http://www.deh.gov.au/erin/ert/epbc/index.html). Accessed September 2010;
- HSO (2004) *Flora and Fauna Assessment box Hill Wind Farm, Ben Lomond Guyra.* Report prepared for Box Hill Wind Farm Pty Ltd;
- HSO (2005a) *Flora and Fauna Assessment Highfields Wind Farm, October 2005*, Energreen Wind Pty Ltd;
- HSO (2005b) *Flora and Fauna Assessment Ben Lomond Wind Farm, August 2005*, Energreen Wind Pty Ltd;
- HSO (2005c) *Flora and Fauna Assessment Ben Lomond North Wind Farm, August 2005*, Energreen Wind Pty Ltd;
- HSO (2008) *Ecological Assessment Report, February 2008*, Ben Lomond Wind Farm Pty Ltd;
- Harper Somers O'Sullivan (HSO) (2005e) *Liverpool Range Wind Farm Nowlands Gap Murrurundi*. Report prepared for Macquarie Generation Pty Ltd. July 2005. (ref 22555).
- Harper Somers O'Sullivan (HSO) (2006) Flora and Fauna Assessment for Black Springs Wind Farm. Report prepared for Wind Corporation Australia Ltd. August 2006. (ref 23219); and
- Planning NSW (2002) *Draft NSW Wind Energy EIA Guidelines*. June 2002.

The following sections contain a detailed description of the methods undertaken for this EAR.

2.2 Flora Survey

Where possible, flora surveys were focused on the areas immediately surrounding proposed turbine locations and associated infrastructure (termed the 'development footprint'), such as cabling and access roads. Air photo interpretation and visual assessment and mapping of larger remnant patches was also undertaken to get an appreciation of the communities and habitats present in the wider locality. However, due to the large numbers of turbines within the proposal (approximately 120) surveys were not conducted at each turbine site as many of these sites were occupied by exotic-dominated pasture species. Survey effort was instead concentrated particularly on areas that were occupied by native vegetation. **Figure 2-1** shows the location of quadrat surveys. Random meander surveys were also conducted throughout a majority of the development envelope area.

Flora Species

Species of plants in the study area were assessed and recorded utilising a combination of both 20 m x 20 m quadrats and the random meander technique (Cropper 1993). Sixteen quadrats were placed throughout the study area; these were placed in some turbine locations and within areas of significant vegetation adjoining turbine sites. The random meander technique involves walking in a random manner throughout the study area and recording all species seen. The time spent in each vegetation community was generally proportional to the size of the community and its species richness.

Vegetation Communities

Flora surveys and vegetation mapping carried out in the study area has been undertaken as follows:

- Aerial Photograph Interpretation (API) to map the community(s) extent into definable map units;
- Confirmation of the community type(s) present (dominant species) via the undertaking of detailed flora surveys and identification; and
- Map the type and general extent of the community(s) present into definable map units where appropriate.

Assessment of the potential for the derived vegetation communities to constitute EEC's as listed within the TSC Act and the EPBC Act was also undertaken. The floristic composition, geomorphological characters and geographic distribution were considered when determining whether an EEC was present.

Plant Identification

It is unreasonable to expect to identify all species from all sites. During this survey when a plant could not be identified accurately within the field, a voucher sample was collected, together with notes on habitat, form and height, labelled and identified according to nomenclature in Harden (1992 – 2002). Opportunistic sightings of taxa were also collected if they were not found in any of the sampled sites. At a minimum, all dominant species were identified in all stratums to a genus level.

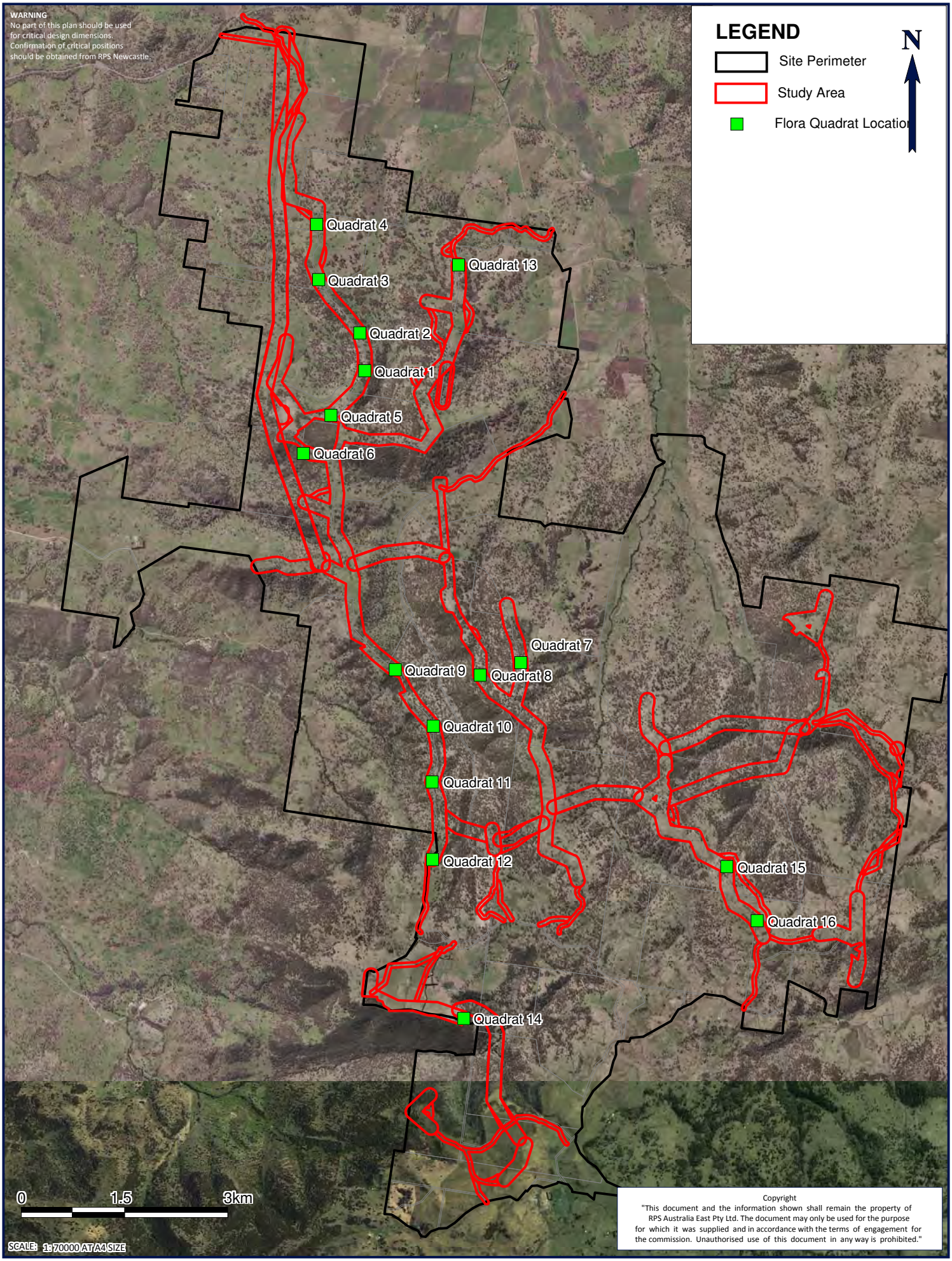
Rare and Significant Species

Targeted searches were undertaken for potentially occurring threatened flora species in the vicinity of the proposed turbines and other infrastructure such as access roads, cabling locations and the substation. These searches were undertaken using sub-metre accuracy GPS Trimble GeoXT to ensure the correct locations were examined.

Floristic Structure Information

Vegetation structure was determined based on Specht *et al,* (1995) by estimation of the height and projected foliage cover (PFC) within each stratum present. All vascular plant species were recorded within each quadrat and species abundances were recorded utilising a modified Braun-Blanquet (1982) cover abundance six ranking scale as follows:

Cover Code	Projected Canopy Cover
1	<5% and uncommon
2	<5% and common
3	6-20%
4	21-50%
5	51-75%
6	76-100%



TITLE: FIGURE 2-1: FLORA QUADRAT LOCATIONS

LOCATION: WHITE ROCK

DATUM: N/A

PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 24/11/2010

PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\104k\104226 Glen Innes\10- Drafting\White Rock\Ecology\Report Figures

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2.3 Fauna Survey

Fauna species present in the study area were recorded through observation methods such as point census bird surveys, incidental sightings, spotlighting, identifying bird and frog calls, searches for ground-dwelling reptile species under logs and leaf litter, and by sighting indirect evidence of species presence such as fauna scats, feathers, tracks and hair. No terrestrial or arboreal mammal trapping was undertaken, given that few impacts were expected to terrestrial and arboreal mammal species.

The focus of surveys was bird and bat species as these are the fauna groups most likely to be impacted by the proposal. In relation to bird surveys the Auswind (2005) guidelines were considered.

Birds - Flight Activity and Behaviour

During the field surveys, bird flight activity and behaviour was observed during bird surveys at 18 different census sites placed in close proximity to proposed wind turbine locations (**Figure 2-2**). These census sites were located amongst groups of turbines to ensure representative sampling across the study area. Bird survey methodology comprised a 20 minute search within a 1.0 ha area at representative potential turbine locations. All species heard or observed were recorded. Survey locations were selected proximate to proposed wind turbine locations and sampled the range of habitat types and topographic locations of the proposed turbine locations.

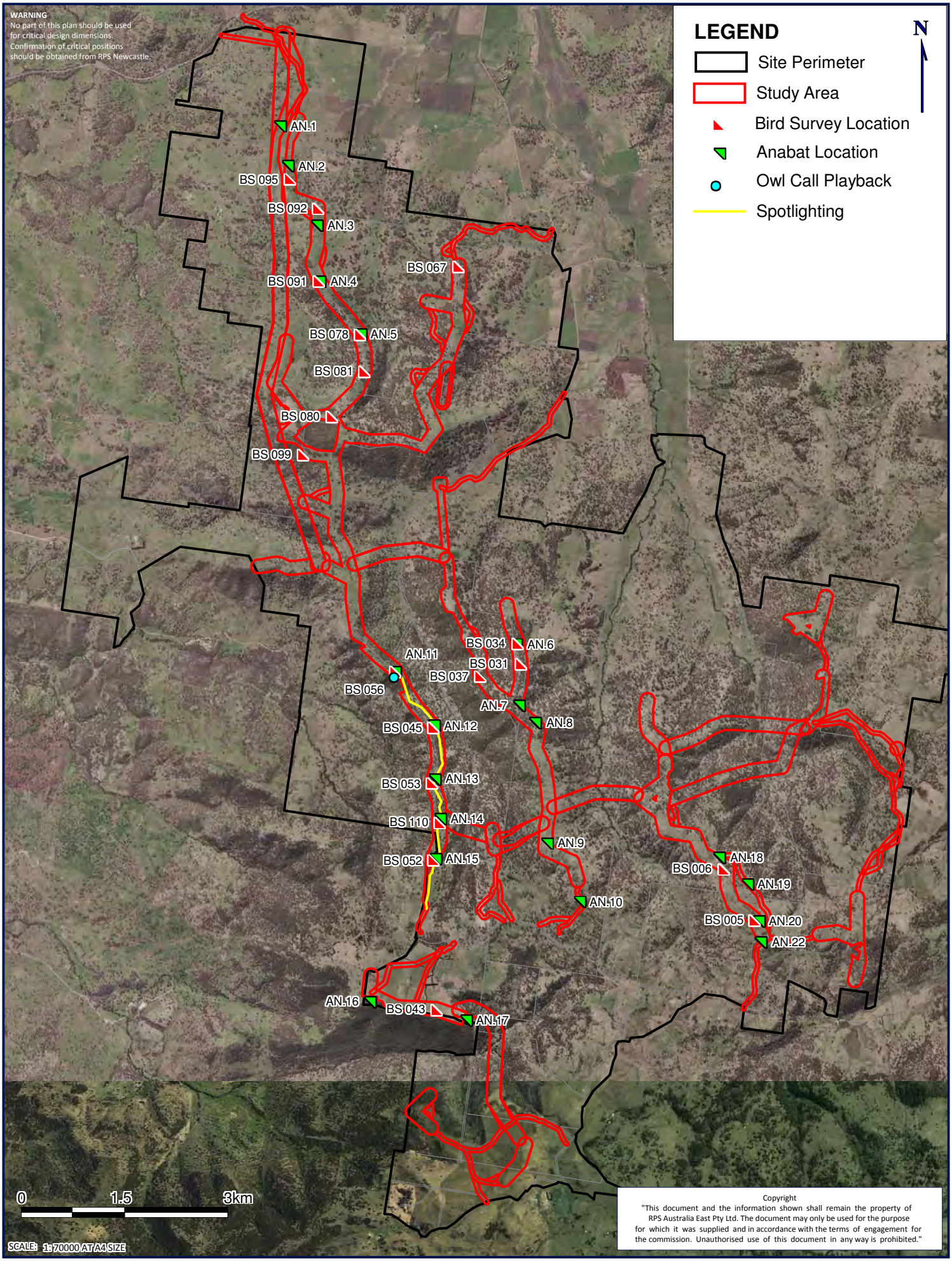
In addition to those species recorded within the 1.0 ha census plots all species observed outside the plot were also recorded to ensure that all species within the vicinity of proposal turbines to determine a measure of relative abundance of different species throughout the study area.

The flight characteristics of individual species were also recorded, with flight height ranges split into:

- 0-20m (well below tip of turbine blade);
- 20-52m (below tip of turbine blade);
- 52-150m (rotor swept area - potential collision zone);
- >150m (above tip of turbine blade).

These observed ranges are approximate only, as heights are recorded by eye at the time of the survey.

Data collected was in accordance with the *Wind Farms and Birds: Interim Standards For Risk Assessment* (Auswind 2005). The surveys were undertaken in various weather conditions and across varying times of the day.



TITLE: FIGURE 2-2: FAUNA SURVEY EFFORT

LOCATION: WHITE ROCK

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 24/11/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\104k\104226 Glen Innes\10- Drafting\White Rock\Ecology\Report Figures

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Bat Call Detection

Bat detectors (ANABAT II with CF ZCAIM) were used to record the echolocations calls of microchiropteran bats within the study area (**Table 2-1**). A total of 21 sites were sampled overnight using stationary bat detectors. Survey locations were selected proximate to proposed wind turbine location groups and sampled the range of habitat types and topographic locations of the proposed turbine locations. The locations of bat detector sites are shown in **Figure 2-2**.

Table 2-1: 2010 Bat Call Recording Sites and Habitat Type

Site	Date	Habitat Type
AN.1	25/9/2010	Cleared paddock with scattered trees
AN.2	25/9/2010	Cleared paddock with scattered trees
AN.3	25/9/2010	Cleared paddock with scattered trees
AN.4	25/9/2010	Cleared paddock with scattered trees
AN.5	25/9/2010	Lightly wooded Ribbon Gum Woodland
AN.6	27/9/2010	Ribbon Gum Woodland
AN.7	27/9/2010	Ribbon Gum Woodland
AN.8	27/9/2010	Ribbon Gum Woodland
AN.9	27/9/2010	Cleared paddock with scattered trees
AN.10	27/9/2010	Cleared paddock with scattered trees
AN.11	28/9/2010	Cleared paddock surrounded by woodland
AN.12	28/9/2010	Ribbon Gum Woodland
AN.13	28/9/2010	Ribbon Gum Woodland
AN.14	28/9/2010	Ribbon Gum Woodland
AN.15	28/9/2010	Ribbon Gum Woodland
AN.16	29/9/2010	Stringybark Forest
AN.17	29/9/2010	Ribbon Gum Woodland
AN.18	30/9/2010	Cleared paddock with scattered trees
AN.19	30/9/2010	Cleared paddock with scattered trees
AN.20	30/9/2010	Cleared paddock with scattered trees
AN.21	30/9/2010	Ribbon Gum Woodland

All bat echolocation calls recorded were analysed by Anna McConville, a qualified bat species call identification ecologist. Relative activity levels (number of passes) were quantified for each species at each site.

Call Playback

Nocturnal animals were surveyed using call playback, whereby recordings of the vocalisations of animals are broadcast to elicit a response, either vocal or behavioural. Species calls used included Barking Owl, Masked Owl and Powerful Owl. At each site there was an initial 10 minute listening period followed by a four minute call broadcast and then a two minute listening and spotlighting period. For each additional species the four and two minute periods were repeated. Calls were broadcast using a portable MP3 player and amplified through a megaphone.

Spotlighting

Spotlighting was undertaken from the vehicle using handheld 100w spotlights, with the approximate speed of survey being 5 km per hour. In addition, the area surrounding each call playback site was spotlighted on foot by two people for around 30 minutes.

2.4 Habitat Assessment

An assessment of the relative value of the habitat(s) present within the study area was undertaken. Whilst this assessment focused primarily on the identification of specific habitat types / resources that are known to be favoured by threatened species recorded from the region, the assessment also considered the potential value of the study area (and surrounds) for all major guilds of native flora and fauna.

This assessment was based on the specific requirements of each species / guild in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements for fauna, and vegetation associations, topography, soil, light and hydrology for flora species and assemblages.

The flora, fauna, and habitat surveys provided an assessment of the potential use of the study area by threatened species (such as listed under the TSC Act and the EPBC Act) identified from the vicinity of the study area.

2.5 Survey Dates, Types and Prevailing Conditions

Table 2-2 shows the dates and prevailing weather during the September/October 2010 survey period.

Table 2-2: Survey Dates, Types and Prevailing Weather

DATE	WEATHER					
	Temp (min. – max.)	*Rain (24 hrs to 9:00am)*	Max Wind Speed/Direction	Cloud Cover	*Sun*	
					Rise	*Set*
25/09/2010	11.3℃-17.0℃	1.6 mm	31km/h - NW	8 eighths	06:09	18:20
26/09/2010	10.0℃ -20.0℃	0.4 mm	15 km/h - NNW	6 eighths	06:08	18:21
27/09/2010	9.5℃ -19.0℃	0 mm	35 km/h - SW	4 eighths	06:07	18:22
28/09/2010	10.0℃ -21.0℃	0.2 mm	54 km/h - WNW	8 eighths	06:06	18:22
29/09/2010	5.5℃ -17.0℃	1.0 mm	50 km/h - W	0 eighths	06:04	18:22
30/09/2010	6.0℃ -16.0℃	0 mm	30 km/h - E	4 eighths	06:03	18:23
01/10/2010	5.0℃ -13.5℃	0 mm	33 km/h - E	7 eighths	06:02	18:24

Source:
Australian Government – Geosciences Australia [http://www.ga.gov.au/ (Location - Glen Innes).
Australian Government – Bureau of Meteorology [http://www.bom.gov.au/climate/] (Location - Glen Innes Ag Research Stn {station 056013}).

2.6 Weed Control

Pasture weeds included some noxious weeds such as Chilean Needle Grass, Blackberry, St John's Wort and Paterson's Curse. To ensure that these and other pasture weeds were not spread between properties whilst the field surveys were performed a wash down of each vehicle using a high pressure hose was performed at the end of each field day and when moving between properties. The spread of noxious weeds will specifically be addressed in the Construction Management Plan. This plan will outline methods to control weeds prior to the commencement of construction and then contain their spread during and post construction. Methods employed will include but not be limited to spraying road ways once constructed and installing wash down facilities at each of the construction compounds to ensure no weeds are transported from the area following the day's construction.

2.7 Limitations

Survey intensity was focused on areas in proximity to the development footprint, and parts of the study area were not visited and/or subject to formal survey techniques. These survey limitations have been taken into account with regards to the assessment of the ecological impacts of the proposed development. The nature of the development is that it is contained primarily within disturbed environments. Not every one of these areas needed specific surveys. The surveys undertaken are considered to provide representative threatened species and communities results for the project to inform this impact assessment.

Weather conditions experienced during the survey may have influenced the survey results in a number of ways such as:

- Windy, cool, cloudy and rainy days may have reduced the level of bird activity at some sites (although such weather conditions are reflective of usual variability in condition in the study area)
- Rainy and windy conditions at night may have reduced bat activity levels during the survey at some sites (although such weather conditions are reflective of usual variability in condition in the study area)
- Access to some areas was limited or restricted due to the wet conditions preventing the safe use of 4WD vehicles. As a result many surveys were conducted on foot resulting in reduced areas being surveyed on the ground than could be using a 4WD.

Timing limitations are often encountered during ecological surveys due to the seasonality of activity and cryptic nature a number of flora and fauna species being studied. There is a range of common albeit cryptic plant species that have a brief flowering period and hence small 'window' of effective 'detect-ability'. In addition, the seasonality of surveys also places limits on the number of flora species identified in the study area. Therefore, some threatened species not detected cannot be discounted off-hand due to seasonality and other factors, and are therefore addressed in terms of their potential for occurrence within the study area based on ecological factors.

Since the proposal footprint limited the removal of potential habitat for threatened fauna species, trapping and nocturnal surveys were not conducted across the study area despite some of the study area offering potential habitat for threatened fauna species. A habitat assessment was undertaken across the study area in place of detailed fauna surveys and the precautionary principle was applied and for some species, where appropriate, assumed presence was made for assessment purposes.

3 Results

3.1 Flora

A total of 87 flora species were identified during the survey period over the White Rock study area within the quadrats and random meander surveys. This included 55 native species and 32 exotic species. A complete list of the flora species identified is provided in **Appendix 1** of this report.

3.1.1 Threatened Flora Species

No rare or threatened flora species were recorded on-site during the current surveys. Records exist for 14 threatened flora species within a 30 km radius on the Atlas of NSW Wildlife. All 14 species are assessed for their potential to occur within the study area in **Section 6**.

A 30 km search of the EPBC Act Protected Matters Search Tool identified 19 threatened flora species. All 19 species are assessed for their potential to occur within the study area in **Section 6**.

3.1.2 Description of Vegetation Communities

The general condition of the vegetation within the study area and wider locality is substantially degraded from over 100 years of European settlement and associated land management practices. Ongoing degradation regimes from cattle and sheep grazing, timber felling, weeds, erosion and feral animals continue to impact upon the native vegetation.

Three vegetation communities have been delineated within the WRWF study area (**Figure 3-1**) and are listed below:

1. **Ribbon Gum – Mountain Gum Woodland (EEC – Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland of the New England Tableland Region);**
2. **Yellow Box Woodland (EEC White Box Yellow Box Blakely's Red Gum Woodland)**; and
3. Cleared Pasture with Scattered Trees.

Descriptions of these communities are provided below.

1 Ribbon Gum – Mountain Gum Woodland (EEC)

Plate 4: Ribbon Gum - Mountain Gum Woodland

This community is the dominant treed community occurring within the study area. This vegetation community encompasses a total of 327 ha within the study area and is commensurate with the TSC Act-listed EEC Ribbon Gum – Mountain Gum – Snow Gum Grassy Forest/Woodland of the New England Tableland Region.

Within the study area this community exists as small (eg. linear roadside reserves, isolated paddock trees) to relatively large intact remnant patches. However the majority of this community has been cleared and modified for agricultural purposes.

<u>*Upper Stratum*</u> – the dominant species being *Eucalyptus viminalis* (Ribbon Gum), *Eucalyptus dalrympleana subsp. heptantha* (Mountain Gum), *Angophora floribunda* (Rough-barked Apple), *Eucalyptus laevopinea* (Silver Top Stringybark) and occasionally *Eucalyptus stellulata* (Black Sallee).

<u>*Mid Stratum 1*</u> – the dominant species being, *Brachychiton populneus* (Kurrajong), *Acacia dealbata (*Silver Wattle) and *Exocarpus cupressiformis* (Cherry Ballart).

<u>*Mid Stratum 2*</u> – the dominant species being *Bursaria spinosa* (Blackthorn), *Melicytus dentatus* (Tree Violet), *Pteridium esculentum* (Bracken Fern) and *Rubus ulmifolius* (Blackberry).

Lower Stratum – where pasture improvement is least, the dominant species being *Dichondra repens* (Kidney Weed), *Poa sieberiana* (Tussock Grass), *Trifolium dubium* (Yellow Suckling Clover), *Galium odoratum* (Woodruff), *Themeda australis* (Kangaroo Grass), *Hydrocotyle laxiflora*, *Trifolium repens* (White Clover) and *Elymus scaber* (Wheat Grass). Otherwise much of this understory of this community is occupied by introduced pasture species.

2 Yellow Box Woodland (EEC)

Plate 5: Yellow Box Woodland

This community occurs within the north of the study area. This vegetation community encompasses a total of 3.4 ha within the study area and is commensurate with the TSC Act EEC White Box Yellow Box Blakely's Red Gum Woodland. It is not commensurate with the EPBC Act EEC equivalent of this vegetation community. The dominant species within this community is *Eucalyptus melliodora* (Yellow Box). The community has been greatly modified throughout the extent that lies within the study area and as such occurs as remnant patches of the community with little mid stratum and an understorey dominated by mainly exotic pasture species.

Upper Stratum – the dominant species being *Eucalyptus melliodora* (Yellow Box), with a patch of *Eucalyptus blakelyi* (Blakely's Red Gum).

Mid Stratum – no mid stratum was detected within the study area.

Lower Stratum –the dominant species being *Festuca* sp. (F*escue*), *Phalaris* sp. and *Avena* sp. (Oats).

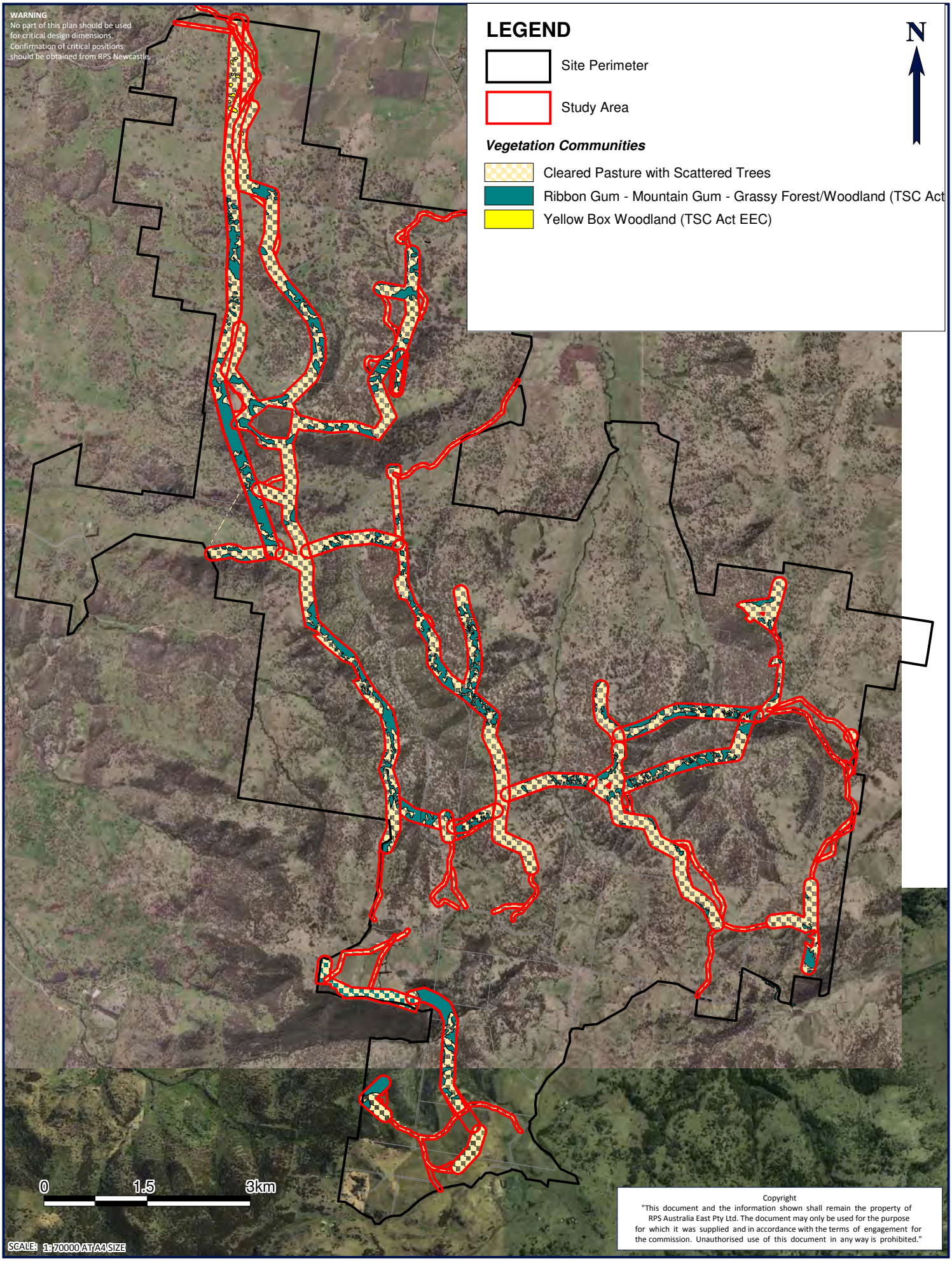
3 Cleared Pasture with Scattered Trees

Plate 6: Cleared Pasture with Scattered Trees

This community is the dominant vegetation type over the study area, occupying approximately 1031 ha. The vast majority of the study area has been historically utilised over the last century for cattle and sheep grazing. These land uses have resulted in dominance of introduced pasture species and exotic grasses and the invasion of thistles, nettles and other numerous weeds.

In structure it is grassland, with some grasses growing up to 1 metre in height, including the introduced *Cynosurus echinatus* (Rough Dog's Tail Grass) and *Phalaris* sp., *Poa sieberiana* (Snow Grass) is also present as a dominant native grass within the pasture areas. Characteristic weeds include *Cirsium vulgare* (Spear Thistle), *Trifolium pratense* (Red Clover), *Rumex brownii* (Swamp Dock), *Urtica urens* (Small Nettle), *Trifolium repens* (Clover), *Taraxacum officinale* (Dandelion), *Marrubium vulgare* (Horehound) and *Verbena bonariensis* (Purpletop). Such species are characteristic of weed-infested pastures in grazing country west of the Great Dividing Range.

Scattered trees consist mainly of a number of *E. melliodora*, *E. viminalis*, *E. dalrympleana subsp. heptantha* and *B. populneus*.



TITLE: FIGURE 3 1 VEGETATION COMMUNITIES

LOCATION: WHITE ROCK

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 23/11/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\104k\104226 Glen Innes\10- Drafting\White Rock\Ecology\ Report Figures

VERSION (PLAN BY): C A4 (PH- NW)

CLIENT: EPURON
JOB REF: 104226

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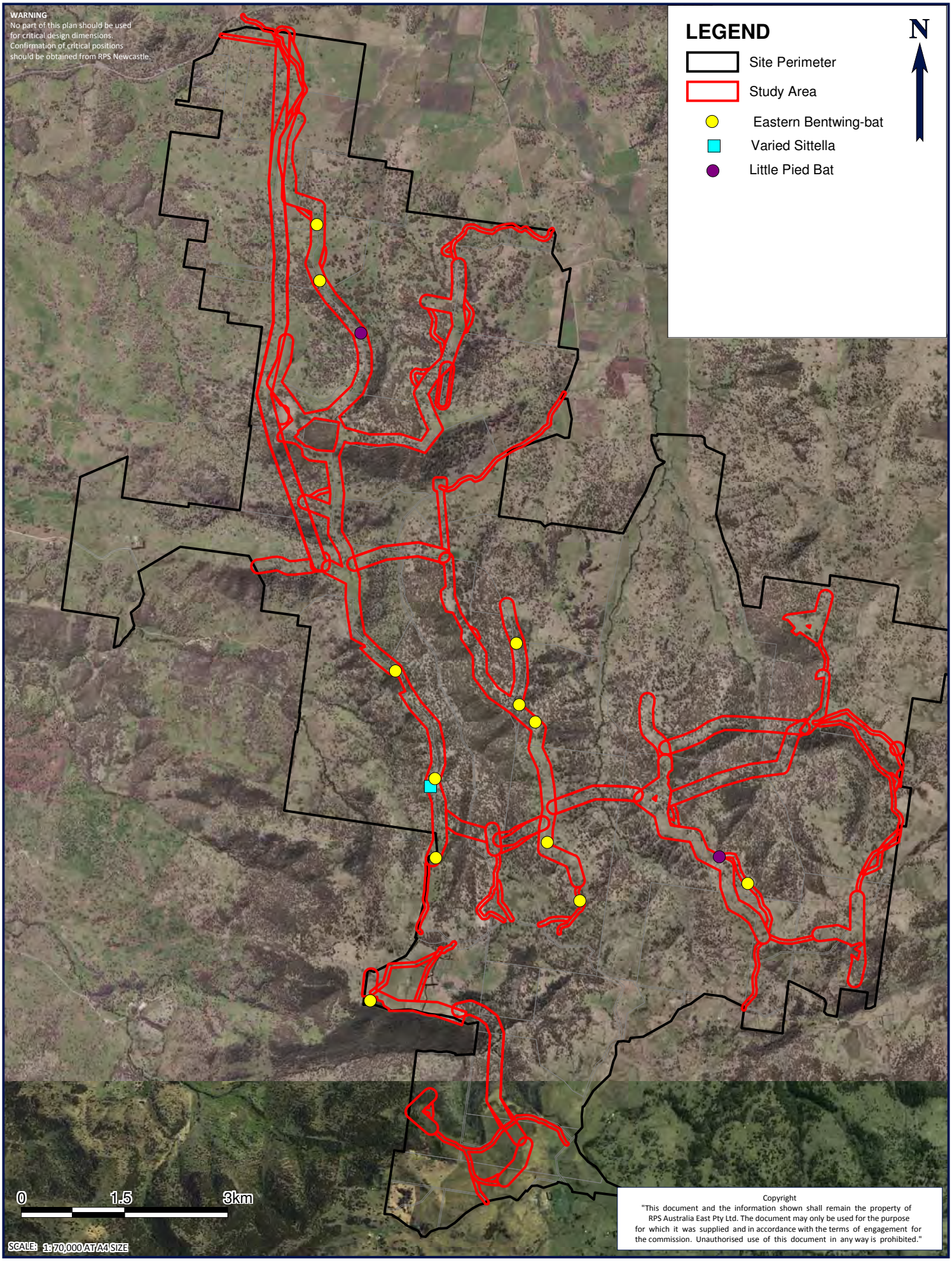
3.2 Fauna

A total of 70 vertebrate fauna species were recorded during formal and opportunistic surveys, comprising 51 bird species, 7 mammals, 1 reptile and 6 amphibians (see Appendix 1). The species recorded, and those that have the potential to occur (see **Table 6-1**) are considered to be typical of the habitats present in the site and in the wider locality.

Three threatened fauna species were recorded during field surveys namely, the Eastern Bentwing-bat (*Miniopterus schreibersii*), Little Pied Bat (*Chalinolobus picatus*) and Varied Sittella (*Daphoenositta chrysoptera*) (**Figure 3-2**). All three species are listed as 'Vulnerable' under the TSC Act.



TITLE: FIGURE 3-2: THREATENED SPECIES LOCATION

LOCATION: WHITE ROCK

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 24/11/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\104k\104226 Glen Innes\10- Drafting\White Rock\Ecology\ Report Figures

VERSION (PLAN BY): B A4 (NW-SC)

CLIENT: EPURON
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3.2.1 Key Observations from Bat Surveys

Two threatened microchiropteran bat species were recorded. The Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), was positively recorded at 12 of 21 sites within the study area (at definite and probable levels of identification – **Table 3-1**). This species is listed as 'Vulnerable' under the TSC Act. The Little Pied Bat (*Chalinolobus picatus*) was recorded at the possible level of identification at two sites within the study area. Under a precautionary principle all 'definite', 'probable' and 'possible' levels of identification are considered positive records. This species is listed as 'Vulnerable' under the TSC Act.

A total of five bat species were identified during the survey comprising the Eastern Bentwing-bat, Little Pied Bat, Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*C. morio*) and White-stripe Freetail Bat (*Tadarida australis*).

Overall, sites within woodland vegetation (i.e. Ribbon Gum Woodland) had the greatest levels of bat activity (as measured by number of detector passes) when compared to cleared sites with scattered trees (see **Table 3-1**). The Eastern Bentwing-bat was the most commonly recorded bat species and was recorded at 11 out of 21 detector sites sampled. In forested habitats, this species flies high above the ground often from just above the canopy (great than 18m) to many times the canopy height, but within open areas it will fly several metres from the ground (Churchill 2008).

Some caves that may be utilised by cave-roosting microchiropteran bat species occur within steep gorges within the southern parts of the site perimeter but will not be affected by the project.

Table 3-1: Identification of Bat Passes recorded in the White Rock area on 25-30 September 2010

Identifications are divided into three categories of confidence: definite, probable and possible (possible category not used here). Values represent number of passes. Habitat type (F - Forest Remnant Edge; CT - Cleared with scattered trees; RGW – Ribbon Gum Woodland; SF – Stringybark Forest)

IDENTIFICATION	AN.1	AN.2	AN.3	AN.4	AN.5	AN.6	AN.7	AN.8	AN.9	AN.10	AN.11	AN.12	AN.13	AN.14	AN.15	AN.16	AN.17	AN.18	AN.19	AN.20	AN.21
HABITAT	**CT**	**CT**	**CT**	**CT**	**RGW**	**RGW**	**RGW**	**RGW**	**CT**	**CT**	**F**	**RGW**	**RGW**	**RGW**	**RGW**	**SF**	**RGW**	**CT**	**CT**	**CT**	**RGW**
DEFINITE																					
Chalinolobus gouldii	1	5	-	-	5	3	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Chalinolobus morio	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miniopterus schreibersii oceanensis	-	-	1	-	-	2	3	1	4	-	1	-	-	-	-	1	-	-	1	-	-
Tadarida australis	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
PROBABLE																					
Chalinolobus gouldi	-	-	1	-	-	-	4	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Chalinolobus morio	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Miniopterus schreibersii oceanensis	-	-	-	1	-	5	6	1	3	7	1	-	1	-	-	3	-	-	-	-	-
POSSIBLE																					
Chalinolobus gouldii	-	5	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-
Chalinolobus morio	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chalinolobus picatus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Miniopterus schreibersii oceanensis	-	-	-	2	-	14	9	1	4	12	3	-	-	-	1	-	-	-	1	-	-
Time of calls recorded (does not necessarily translate to survey effort, simply when calls were recorded)	Entire Night	Entire Night	Entire Night	Entire Night	6:13pm – 9:00pm	Entire Night	Entire Night	Entire Night	Entire Night	Entire Night	Entire Night	Entire Night	7:18pm – 1:59am	Entire Night	Entire Night	6:19pm – 9:37pm	4:35pm – 9:23pm	6:21pm – 11:24pm	7:27pm – 11:49pm	4:30pm – 7:49pm	4:55pm – 5:05pm

3.2.2 Key Observations from Bird Surveys

A total of 48 bird species were recorded from 18 survey sites. Thirty five of the 48 bird species were recorded from visual sightings and flight height data was collected. The remaining 13 species were recorded from calls and flight height data was not able to be collected.

Table 3-2 shows the individual species, the number of times each species was recorded in each height zone, the preferred habitat type, typical movement pattern type and typical flight speed category.

A single threatened bird species, the Varied Sittella (*Daphoenositta chrysoptera*) was recorded on a single occasion. The Varied Sittella is listed as Vulnerable on the TSC Act. A single migratory species, the Rainbow Bee-eater (*Merops ornatus*), was recorded at two sites. The Rainbow Bee-eater is listed as Migratory species on the EPBC Act.

Four species were recorded within the height range of the turbine blades (52 to 150m), otherwise known as the Rotor Swept Area (RSA). The Wedge-tailed Eagle (*Aquila audax*) was recorded twice within the RSA and a further six times above or below the RSA. The Nankeen Kestrel (*Falco cenchroides*) was recorded three times within the RSA, and four times above or below the RSA. Two parrots, the Galah (*Eulophus roseicapillus*) and Rainbow Lorikeet (*Trichoglossus haematodus*) were recorded once each within the RSA.

Nine bird species were recorded up to a maximum height zone of 21 to 51 metres, below the height of the RSA. Twenty six bird species were recorded up to a maximum height zone of 0 to 20 metres, well below the height of the RSA

The most commonly recorded species were the Red Wattlebird (*Anthochaera carunculata,* 24 records), Crimson Rosella (*Platycercus elegans*, 12 records), Rainbow Lorikeet (*Trichoglossus haematodus*, 11 records) and Australian Magpie (*Gymnorhina tibicen*, nine records) (**Table 3-2**).

Table 3-2: Results of Formal and Opportunistic Bird Census

Species	Height Ranges Frequented (metres)				Habitat Preference	Movements	Flight Speed
	0-20	21-52	52-150	>150			
Australian Wood Duck	1				Wetlands	Locally nomadic	Med - Swift
Wedge-tailed Eagle	1	1	2	4	Forest/Woodland/ Grassland	Sedentary (large territory)	Slow – Swift
Nankeen Kestrel	2	1	3	1	Grassland/ Woodland edges	Sedentary/Dispersive	Slow – Swift
Galah	2		1		Woodland/Grassland	Locally nomadic	Med
Sulphur-crested Cockatoo	1				Forest/Woodland/Grassland	Locally nomadic	Med
Rainbow Lorikeet	4	6	1		Forests and Woodlands	Nomadic	Swift
Scaly-breasted Lorikeet	1				Forests and Woodlands	Nomadic	Swift
Musk Lorikeet	5				Forests and Woodlands	Nomadic	Swift
Crimson Rosella	12				Forest	Sedentary	Med
Eastern Rosella	5				Forest/Woodland/Grassland	Sedentary	Med
Fan-tailed Cuckoo					Forest	Migratory Sedentary	Med
Shining Bronze-cuckoo					Forest/Woodlands	Migratory Sedentary	Med
Laughing Kookaburra	2	1			Forest/Woodland	Sedentary	Slow - Med
Sacred Kingfisher					Forest	Sedentary	Med
Rainbow Bee-eater	1	1			Forest/Woodland/Grassland	Locally nomadic/Seasonal migrant	Slow - Med
White-throated Treecreeper					Forest	Sedentary	Med
Superb Fairy-wren	1				Forest/Woodland/Grassland	Sedentary	Slow
Spotted Pardalote					Forest/Woodland	Sedentary Locally Nomadic	Slow - Med
Striated Pardalote	6				Forest/Woodland	Sedentary	Slow - Med
Brown Thornbill	2				Forest/Woodland	Sedentary	Slow
Buff-rumped Thornbill	5				Forest/Woodland	Sedentary	Slow
Yellow-rumped Thornbill	1				Woodland/Grassland	Sedentary	Slow
Striated Thornbill	1				Forest/Woodland	Sedentary	Slow
Red Wattlebird	16	6			Forest/Woodland	Sedentary Nomadic	Slow - Med
Noisy Friarbird	6	2			Forest/Woodland	Locally nomadic	Med
Noisy Miner	3	1			Forest/Woodland	Sedentary	Slow - Med
Yellow-faced Honeyeater	7				Forest/Woodland	Locally nomadic/Seasonal migrant	Med
White-eared Honeyeater	1				Forest/Woodland	Sedentary	Slow - Med
Brown-headed Honeyeater					Forest/Woodland	Sedentary	Slow – Med
White-naped Honeyeater	3				Forest/Woodland	Sedentary	Slow – Med
Eastern Spinebill	4				Forest/Woodland	Sedentary	Med - Swift
Varied Sittella	1				Forest/Woodland	Sedentary	Slow – Med
Rufous Whistler	1				Forest/Woodland	Sedentary Breeding Migrant	Slow - Med
Grey Shrike-thrush					Forest/Woodland	Sedentary	Med
Leaden Flycatcher					Forest/Woodland	Sedentary Breeding Migrant	Slow – Med

Species	Height Ranges Frequented (metres)				Habitat Preference	Movements	Flight Speed
	0-20	21-52	52-150	>150			
Magpie-lark					Forest/Woodland/Grassland	Sedentary	Slow – Med
Grey Fantail	1				Forest	Sedentary/Seasonal Migrant	Slow
Black-faced Cuckoo-shrike	2	1			Forest/Woodland	Locally nomadic	Med
Woodswallow sp.		1			Forest/Woodland/Grassland	Sedentary Migratory	Slow – Med
Grey Butcherbird	1				Forest/Woodland	Sedentary	Med - Swift
Australian Magpie	6	3			Forest/Woodland/Grassland	Sedentary	Med – Swift
Pied Currawong	3				Forest/Woodland	Locally nomadic	Med – Swift
Australian Raven		1			Forest/Woodland/Grassland	Locally nomadic	Med
Pied Butcherbird	1				Forest/Woodland	Sedentary	Med
Mistletoebird					Forest/Woodland	Sedentary	Med - Swift
Welcome Swallow	1				Forest/Woodland/Grassland	Seasonal nomad	Slow - Med
Silvereye	1				Forest	Seasonal nomad	Med
Common Starling	1				Exotic Pest	Locally nomadic	Swift

Key: *= Species commonly recorded at this height range (11+ observations)*
= Species occasionally recorded at this height range (6 – 10 observations)
= Species rarely recorded at this height range (1 – 5 observations)

3.3 Habitat Attributes

The study area is typical of the wider bioregion and all properties within it are managed as active grazing properties. Flora and fauna habitats primarily consist of four broad habitat types: woodland; creek lines, farm dams, and cleared areas with and without scattered trees.

Many of the native flora and fauna species recorded or considered likely to occur on the site are those tolerant of the variegated landscape. A number of other species that have specific habitat requirements (including many threatened species) are no longer present within the locality. The most suitable habitat for native species occurs within the larger remnant forest patches.

These forested areas offer potential habitat for a variety of native fauna. A variety of bird species may use the forested habitats, particularly during flowering periods. Nesting habitat also exists for many bird species, including for larger cavity-dependant species such as owls and parrots. Potential habitat for terrestrial, arboreal, and flying mammals also exists, including nesting / roosting habitat in the form of tree hollows. Caves that provide roosting habitat for cave-dwelling microchiropteran bats are also known to occur in the broader site perimeter, although do not occur within the study area itself.

Elsewhere, isolated paddock trees or small remnant patches of less than 1ha occur in otherwise cleared areas (see **Figure 1-2**). Whilst larger remnants provide most ecological attributes, scattered trees are also considered to play an important role in ecosystem functioning and productivity, and have been shown to be an important habitat feature for fauna, including foraging insectivorous bats (Lumsden & Bennett 2000). A number of bird

species were noted foraging and nesting in scattered trees. Dieback, senescence, and lack of recruitment due to grazing threatens the longer-term viability of scattered farm trees and hence this habitat resource within the study area.

Historical clearing and selective tree lopping have substantially reduced the density of tree hollows throughout forested areas. It is likely that the demand for hollows is likely to exceed that which is currently available and the availability of hollows is likely to be a limiting factor for the size and distribution of hollow dependent fauna populations.

The numerous small farm dams throughout the area provide habitat for wetland / water birds and frogs. Creek lines are generally degraded through clearing, erosion, sedimentation, and cattle and sheep impacts such as trampling of riparian vegetation and contributing to bank erosion. The upper reaches of Falls Creek provide the most intact areas of freshwater habitat including for small freshwater fish and crustaceans.

In forested areas where a grassy understorey occurs and/or in cleared areas, habitat for macropods exists and where present, leaf litter may be used by reptiles and small mammals. The cleared areas provide little habitat for native species aside from potential foraging habitat for macropods or granivorous birds.

Ongoing patterns of degradation from weeds, erosion, grazing, and feral animals continue to impact upon the above mentioned habitat attributes such that the current biological diversity of the study area has been significantly reduced.

Feral and domestic animals including foxes, goats, rabbits, European hares, cattle and sheep impact on habitat attributes in a number of ways, including reduction in native fauna populations, simplification of understorey and pollution of water bodies. Grazing in particular has lead to a depletion of the understorey, decline of native grass and forb species richness, and inhibits the regeneration of trees.

Individual proposed turbine sites were typically characterised by treeless pasture areas either close to existing woodland remnants or within larger treeless pasture areas. Areas between proposed turbines and along proposed access paths often contained areas of remnant woodland vegetation.

3.4 Significant Habitats within the Locality

The region (Inverell, Glen Innes Severn LGA's) supports a number of ecologically significant areas. These include:

- Little Llangothlin Nature Reserve - listed as a wetland of international significance (RAMSAR site), and located approximately 27km south-east of the study area. Over 100 bird species have been recorded in the nature reserve and it regularly supports large numbers of waterfowl and waders, some of which nest in the reserve. The range of birds using the nature reserve is due to the varied habitats in both Little Llangothlin Lagoon and Billy Bung Lagoon, and the remnant vegetation surrounding these water bodies. These habitats are of special value in supporting vulnerable and rare species

such as the comb-crested jacana (*Irediparra gallinacea*) and the blue-billed duck (*Oxyura australis*). Little Llangothlin Lagoon is of special value as a drought refuge for many species of water birds (NPWS 1998);

- Llangothlin Lagoon - recognised as a nationally important wetland and located approximately 27km south-east of the study area; and
- Mother of Ducks Lagoon - recognised as a nationally important wetland and located approximately 37km south of the study area;

These wetland areas have been identified as a 'potential source' of bird strikes.

In addition to these wetland areas, several National Parks also occur within the locality including:

- Warra National Park – old growth forest with habitat for a number of threatened flora and fauna species. Located approximately 30 km south-east of the study area;
- Single National Park – located approximately 15 km south-west of the study area; and
- Indwarra National Park – located approximately 35km south-west of the study area.

A number of other important habitat areas / resources occur elsewhere within the locality and wider region, including key habitats and corridors, as detailed below in **Section 3.5**.

3.5 Key Habitats and Corridors

3.5.1 Background

The NSW National Parks and Wildlife Service (now DECCW) has undertaken a “Key Habitat and Corridors (KHC)” project to assist with conservation in north-east NSW. The KHC project has adopted a systematic approach to landscape conservation in north-east NSW.

Distributional information for forest fauna has been summarised and integrated to identify important areas for conservation. These areas are:

- regional fauna key habitats; and
- linking habitat corridors.

Using Geographic Information System (GIS) analysis tools, potential landscape linkages (habitat corridors) have been derived based on the predicted distributions of priority fauna species assemblages. The mapped key habitats are areas of predicted high conservation value for forest fauna, and include many large areas of vegetated lands and important vegetation remnants. A framework of corridors has been mapped to provide connectivity between these areas across the landscape. A habitat corridor facilitates important ecological processes such as migration, colonisation and interbreeding of plants and animals between two or more larger areas of habitat.

It should be noted that vegetation cover in corridors depicted in the KHC project may not always be continuous. Mapped corridors may include smaller remnants, wetlands, roadside vegetation, groups of trees, and even individual trees. Corridors may even be broken, or fragmented, by currently degraded or cleared areas and still contribute to landscape connectivity. Discontinuous corridors often provide important stepping-stone links and many are immediately identifiable as focus areas for habitat restoration programs.

Whilst the KHC map layers are suitable for regional assessments, at a site-specific level, application and interpretation of the data is somewhat limited due to a number of factors such as spatial accuracy and by the fact that the mapping has not been formally field tested.

Therefore more site-specific field surveys are required for development proposals that may potentially impact upon these habitats and corridors.

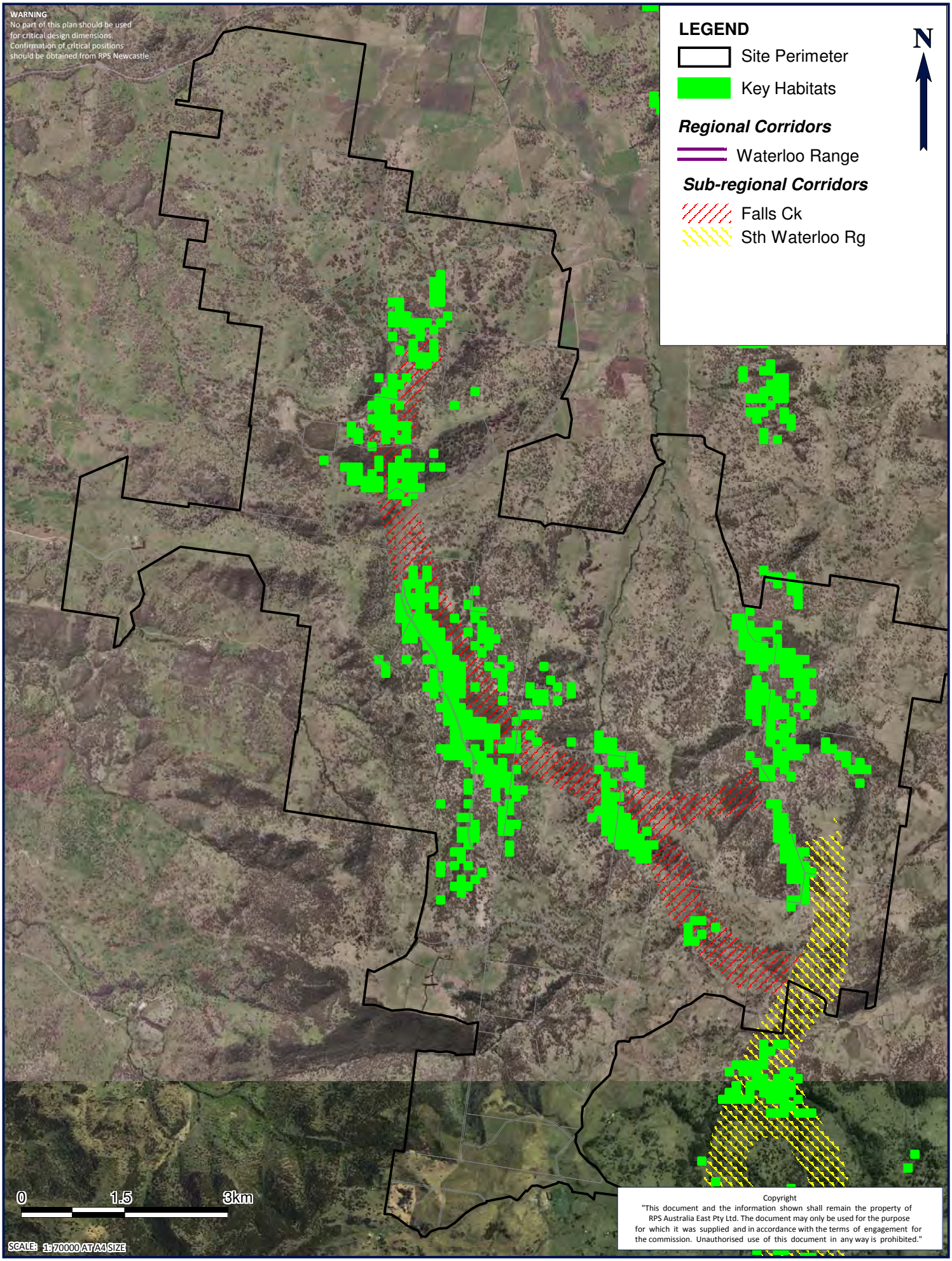
3.5.2 Key Habitats and Corridors at White Rock

As shown in **Figure 3-3**, key habitats and corridors have been identified by NSW National Parks and Wildlife, through the project area. These include:

- **Key Habitats** (forested gully / slope vegetation along White Rock Creek, Falls Creek, Oaky Creek and Wellingrove Creek catchment areas consisting of the more intact stands of Ribbon Gum - Mountain Gum - Snow Gum Grassy Forest/Woodland).
- **Regional Corridor - Waterloo Range** (this corridor is a link between South Waterloo Range and large tracks of habitat to the north, incorporating Kings Plains National Park and the Severn River Nature Reserve). The Waterloo Range Corridor is derived from the following fauna assemblages: Dry Western Tablelands and - Dry Granite Tablelands. Further information on the fauna assemblages associated with the Waterloo Range Corridor is shown in **Table 3-3**.
- **Subregional Corridor - South Waterloo Range** (this corridor is a link between Wellingrove Creek and Clerks Creek). The South Waterloo Range Corridor is derived from the following fauna assemblages: Dry Western Tablelands; - Southern New England Tablelands; and - Dry Granite Tablelands. Further information on the fauna assemblages associated with the South Waterloo Range Corridor is shown in **Table 3-3.**
- **Subregional Corridor – Falls Creek** (this corridor links to the South Waterloo Range). The Falls Creek Corridor is derived from the following fauna assemblages: Dry Western Tablelands. Further information on the fauna assemblage associated with the Falls Creek Corridor is shown in **Table 3-3**.

Table 3-3: Sub-regional Corridor Fauna Assemblages

Fauna Assemblage	Brief	Priority Species
Dry Western Tablelands	This assemblage of six species occupies vulnerable dry open forest and woodland habitats on non-granite substrates, which are typically more productive environments subject to loss and fragmentation of habitat associated with grazing and cropping. These are important habitats for threatened species including the Bush Stone-curlew, Hooded Robin, Grey-crowned Babbler and Painted Honeyeater.	Musk Lorikeet (*Glossopsitta concinna*), Hooded Robin (*Melanodryas cucullata*), Grey-crowned Babbler (*Pomatostomus temporalis*), Yellow-tufted Honeyeater (*Lichenostomus melanops*), Painted Honeyeater (Gra*ntiella picta*), Bush Stone-curlew (*Burrhinus grallarius*)
Southern New England Tablelands	Comprising five species, this assemblage is compositionally very similar to the Lower North Coast Tablelands assemblage of the Lower North Coast, and occupies similar high-elevation open forests in the central and southern parts of the Tablelands analysis area, typically at the drier end of the moisture gradient.	Bibron's Toadlet (*Pseudophryne bibroni*), Mountain Dragon (*Tympanocryptis diemensis*), Montane Sunskink (*Lampropholis caligula*), Alpine Copperhead (*Austrelaps ramsayi*), White-lipped Snake (*Drysdalia coronoides*)
Dry Granite Tablelands	The seven species comprising this assemblage typically occupy habitats on granite substrates in the north-western parts of the TAB analysis area. Key habitats occur within Torrington State Recreation Area and west of Armidale, in reserved and freehold tenures, where potential corridors link widely across freehold tenures.	Border Thick-tailed Gecko (*Underwoodisaurus sphyrurus*), Brown-backed Yellow-lined Ctenotus (*Ctenotus eurydice*), Superb Lyrebird (*Menura novaehollandiae*), Chestnut-rumped Heathwren (*Hylacola pyrrhopygia*), Inland Broad-nosed Bat (*Scotorepens balstoni*), Greater Broad-nosed Bat (*Scoteanax rueppellii*), Turquoise Parrot (*Neophema pulchella*)



TITLE: FIGURE 3-3: NPWS KEY HABITATS AND CORRIDORS

LOCATION: WHITE ROCK

DATUM: N/A
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 23/11/2010
PURPOSE: REPORT FIGURE

LAYOUT REF: J:\JOBS\104k\104226 Glen Innes\10- Drafting\White Rock\Ecology\ Report Figures

VERSION (PLAN BY): B A4 (PH -NW)

CLIENT: EPURON
JOB REF: 104226

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